IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.:	**10/605,039**
Application of:	**Jacobson et al.**
Confirmation No. :	**2038**
Filed:	**September 3, 2003**
Group Art Unit:	**3742**
Examiner:	**Paschall, Mark H.**
Attorney Docket No.:	**H-355**
Customer No.:	**26245**

Cambridge, Massachusetts
October 6, 2010

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Sir:

This is an appeal from the non-final rejection of all claims of the above application as set forth in the Office Action mailed October 16, 2009.

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REAL PARTY IN INTEREST

The real party in interest in this appeal is E Ink Corporation, the assignee of record, a corporation organized and existing under the laws of the State of Delaware, of 733 Concord Avenue, Cambridge, MA 02138-1002. E Ink Corporation is now a wholly owned subsidiary of E Ink Holdings, Inc. of Hsinchu, Taiwan.

RELATED APPEALS AND INTERFERENCES

There are no related appeals and interferences.

STATUS OF CLAIMS

Claims 1-8 are pending in this application, claims 9-20 having been cancelled during earlier prosecution. All pending claims stand rejected. No claim is objected to. No claim is subject to a restriction or election requirement. All claims are appealed. A copy of the claims on appeal appears in the Appendix to this Brief.

STATUS OF AMENDMENTS

All Amendments filed during prosecution of this application have been entered (there have been eight non-final Office Actions in this case). No Amendment was filed after the non-final Office Action of October 16, 2009 from which this appeal was taken.

SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1 (see Paragraphs 50-60 of the specification) is directed to an electrophoretic medium (102 in Figure 1A) comprising a plurality of capsules (104 in Figure 1A; 202 in Figures 2, 3A and 3B), each capsules comprising an internal phase comprising a plurality of electrophoretically mobile particles (108 in Figure 1A; 210 in Figures 2, 3A and 3B) in a gaseous suspending medium (208 in Figures 2, 3A and 3B), and a capsule wall (212 in Figures 2, 3A and 3B) surrounding the internal phase.

Claim 2 (see Figures 2, 3A and 3B and the related description at Paragraphs 58-60) is directed to an electrophoretic medium according to claim 1 wherein each capsule (202) comprises a single type of electrophoretically mobile particle (212), each capsule having a pair of opposed surfaces differing in size (see Figures 3A and 3B, in which each capsule 212 has a substantially triangular prismatic form with a large upper (as illustrated) surface 214 and a small lower surface 216).

Claim 3 is directed to an electrophoretic medium according to claim 1 comprising two types of particles having differing optical characteristics and differing electrophoretic mobilities. See Figures 1A and 1B and the related description at Paragraphs 50-56, where the capsules 104 contain a large number of uncharged white particles 106 (having essentially zero electrophoretic mobility) and a smaller number of positively charged black particles 108 (which have a substantial electrophoretic mobility).

Claim 4 is directed to an electrophoretic medium according to claim 3 wherein one type of particle has substantially zero electrophoretic mobility. As noted in the preceding paragraph, the capsules 104 in Figure 1A contain a large number of uncharged white particles 106 having essentially zero electrophoretic mobility.

Claim 5 is directed to an electrophoretic medium according to claim 3 wherein the two types of particles bear charges of the same polarity but differ in electrophoretic mobility. See the last sentence of Paragraph 13 of the specification.

Claim 6 is directed to an electrophoretic medium according to claim 1 wherein the capsule walls of a plurality of capsules are merged with one another, so that the medium comprises a plurality of bubbles, each containing the electrophoretically mobile particles and the gaseous suspending medium, the bubbles being dispersed in a continuous solid phase. See Paragraph 14 of the specification.

Claim 7 is directed to an electrophoretic medium according to claim 1 wherein the gaseous suspending medium comprises carbon dioxide. See Paragraph 15 of the specification; see also Paragraph 39 for a discussion of the advantages of using carbon dioxide as a supercritical fluid in the manufacture of electrophoretic media of the present invention.

Finally, claim 8 is directed to an electrophoretic display comprising an electrophoretic medium according to claim 1 and at least one electrode disposed adjacent the electrophoretic medium and arranged to apply an electric field to the medium. See the Figures, specifically electrodes 110 and 112 in Figure 1A, and the electrodes provided on substrates 204 and 206 in Figure 2, as described in the last sentence of Paragraph 58 of the specification.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1-8 stand rejected under 35 USC 103(a) as unpatentable over the disclosed prior art in the specification in view of Yamaguchi et al., U. S. Patent No. 6,636,186 (hereinafter "Yamaguchi").

Claims 1-8 stand rejected under 35 USC 103(a) as unpatentable over the disclosed prior art in the specification in view of either Yakushiji et al., U. S. Patent Application Publication No. 2005/0001810 (hereinafter "Yakushiji") or Kitano et al., U. S. Patent Application Publication No. 2005/0052042 (hereinafter "Kitano".

ARGUMENT

Summary

Claims 1-8 are not obvious over the disclosed prior art in the specification in view of any of the three secondary references because none of these references, when read in conjunction with the admitted prior art described in the present specification, would teach a person of ordinary skill in the relevant art that it was possible to produce an electrophoretic medium as defined in any of the present claims.

Detailed argument

It is believed that there is no significant dispute between the Examiner and the applicants as to the facts relevant to this appeal; the applicants and the Examiner differ as to the legal conclusions to be drawn from these facts.

The introductory part of the present application recites that electrophoretic displays have been the subject of intense research and development for a number of years. Such displays can have attributes of good brightness and contrast, wide viewing angles, state bistability, and low power consumption when compared with liquid crystal displays. Nevertheless, problems with the long-term image quality of these displays have prevented their widespread usage. For example, particles that make up electrophoretic displays tend to settle, resulting in inadequate service-life for these displays. (See Paragraph 3 of the present specification.)

The present application further recites that numerous patents and applications assigned to or in the names of the Massachusetts Institute of Technology (MIT) and E Ink Corporation have recently been published describing encapsulated electrophoretic media. Such encapsulated media comprise numerous small capsules, each of which itself comprises an internal phase containing electrophoretically mobile particles suspended in a liquid suspension medium, and a capsule wall surrounding the internal phase. Typically, the capsules are themselves held within a polymeric binder to

form a coherent layer positioned between two electrodes.. (See Paragraph 4, especially the listing of E Ink patents therein.)

Known electrophoretic media, both encapsulated and unencapsulated, can be divided into two main types, referred to hereinafter for convenience as "single particle" and "dual particle" respectively. A single particle medium has only a single type of electrophoretic particle suspending in a colored suspending medium, at least one optical characteristic of which differs from that of the particles. (See Paragraph 5, first two sentences.) A dual particle medium has two different types of particles differing in at least one optical characteristic and a suspending fluid which may be uncolored or colored, but which is typically uncolored. The two types of particles differ in electrophoretic mobility; this difference in mobility may be in polarity (this type may hereinafter be referred to as an "opposite charge dual particle" medium) and/or magnitude. (See Paragraph 6, first two sentences.) If the two types of particles have charges of the same polarity, but differ in electrophoretic mobility, the medium may be referred to as a "same polarity dual particle" medium. (See Paragraph 7, first sentence.)

Many E Ink patents and applications recognize that the walls surrounding the discrete microcapsules in an encapsulated electrophoretic medium could be replaced by a continuous phase, thus producing a so-called "polymer-dispersed electrophoretic display" in which the electrophoretic medium comprises a plurality of discrete droplets of an electrophoretic fluid and a continuous phase of a polymeric material, and the discrete droplets of electrophoretic fluid within such a polymer-dispersed electrophoretic display may be regarded as capsules or microcapsules even though no discrete capsule membrane is associated with each individual droplet; see for example, the U.S. Patent Application Publication No. 2002/0131147. (See Paragraph 9.)

Electrophoretic media require the presence of a suspending fluid. In all the specific embodiments discussed in the E Ink patents and applications referred to above, this suspending fluid is a liquid. Unencapsulated electrophoretic media using

gaseous suspending fluids are known (see, for example, Kitamura, T., et al., "Electrical toner movement for electronic paper-like display", IDW Japan, 2001, Paper HCS1-1, and Yamaguchi, Y., et al., "Toner display using insulative particles charged triboelectrically", IDW Japan, 2001, Paper AMD4-4) and such gas-based electrophoretic media appear to be susceptible to the same types of problems due to particle settling as liquid-based electrophoretic media, when the media are used in an orientation which permits such settling, for example in a sign where the medium is disposed in a vertical plane. Indeed, particle settling appears to be a more serious problem in gas-based electrophoretic media than in liquid-based ones, since the lower viscosity of gaseous suspending fluids as compared with liquid ones allows more rapid settling of the electrophoretic particles. (See Paragraph 11.)

In the light of the foregoing summary of the state of the art regarding electrophoretic displays, the possibility of producing capsules using gaseous suspending fluids rather than liquid suspending fluids might occur to a skilled worker. However, there is a major practical problem. Most of the E Ink patents and applications listed in Paragraph 4 of the present specification describe two basic processes for producing encapsulated electrophoretic media. As discussed in Paragraph 28 of the present specification, encapsulated electrophoretic media (other than polymer-dispersed media) are typically produced by forming a dispersion of the electrophoretic particles in the liquid suspending fluid (which is normally a hydrocarbon, alone or in admixture with a halocarbon). This dispersion then flows, under high shear conditions, into a immiscible liquid containing a precursor of the material which will form the capsule wall. The high shear conditions cause the dispersion to form small droplets within the immiscible liquid, and coacervation of the wall material takes place around these droplets to form the capsules. A curing agent may be added to increase the mechanical strength of the capsule walls so produced. For a more detailed illustration of this type of process, see, for example U. S. Patent Application Publication No. 2002/0180687, at Paragraphs 56-74.

Polymer-dispersed encapsulated electrophoretic media, on the other hand, are typically prepared by first forming the same type of dispersion of the electrophoretic particles in a liquid suspending fluid. This dispersion is then emulsified in a liquid medium containing a film-forming material, and the resultant emulsion is placed under conditions which cause the liquid medium to form the solid continuous phase of the polymer-dispersed electrophoretic medium. See, for example, the aforementioned 2002/0131147, especially the worked Examples at Paragraphs 51-55.

Neither of these processes can be used to form an electrophoretic medium in which the suspending fluid is gaseous, since in both cases the process relies upon (a) formation of a relatively stable dispersion of electrophoretic particles in the suspending fluid; and (b) formation of a stable droplet of electrophoretic particles/suspending fluid around which a capsule wall or continuous phase can be formed. It will readily be apparent that, when one attempts to use a gaseous suspending fluid, the relatively dense electrophoretic particles will not form a stable smoke in the gaseous suspending fluid, and will tend to precipitate out of the gas; even if this does not result in complete destruction of the internal phase comprising the electrophoretic particles and the gas, it will inevitably result in contact between the electrophoretic particles and the liquid or semi-solid material from which the capsule wall or continuous phase is being formed, thus causing the electrophoretic particles to stick to the liquid or semi-solid material and thus rendered incapable of moving through the gas when an electric field is applied. Such immobilization of the electrophoretic particles will thus destroy the functioning of the electrophoretic medium, which is dependent upon the free movement of the electrophoretic particles under the influence of electric fields.

With regard to point (b), it will readily be apparent that a light bubble containing gas and electrophoretic particles will be much less likely to remain suspended in a liquid or semi-solid medium than a droplet containing a suspending liquid and electrophoretic particles. In particular, it will be difficult if not impossible to maintain

such a bubble suspended in a liquid medium for the lengthy period needed to carry out the encapsulation process of the aforementioned 2002/0180687, while use of gaseous bubbles rather than liquid droplets in the process described in the aforementioned 2002/0131147 is likely to result in a highly non-uniform distribution of the discontinuous phase within the continuous phase.

For all the foregoing reasons, the prior art acknowledged in the introductory part of the present application would not teach a skilled person how to produce a gas-based electrophoretic medium of the present invention.

The secondary references applied in the Office Action add essentially nothing to the prior art acknowledged in the present application. All three secondary references relate to the production of *microcell* electrophoretic media using gaseous suspending fluids. Such microcell media are produced by first forming a set of self-supporting microcells (see for example Figures 12 and 13 of Yakushiji and the related description), placing the electrophoretic particles and the suspending fluid within the microcells, and then sealing the microcells (see for example Paragraph 475 of Yakushiji). Because the preformed microcells are self-supporting and indeed essentially rigid, this process is not substantially changed whether a liquid or a gaseous suspending fluid is used. However, these secondary references would not teach a skilled person anything about how to modify the prior art processes described in the present application to permit them to be employed to form *capsules* containing gaseous suspending fluids.

For all of the foregoing reasons, the rejections of the claims on appeal should be reversed and the application allowed.

Respectfully submitted
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CLAIMS APPENDIX

Claims on Appeal

1. An electrophoretic medium comprising a plurality of capsules, each capsule comprising an internal phase comprising a plurality of electrophoretically mobile particles in a gaseous suspending medium, and a capsule wall surrounding the internal phase.

2. An electrophoretic medium according to claim 1 wherein each capsule comprises a single type of electrophoretically mobile particle, each capsule having a pair of opposed surfaces differing in size.

3. An electrophoretic medium according to claim 1 comprising two types of particles having differing optical characteristics and differing electrophoretic mobilities.

4. An electrophoretic medium according to claim 3 wherein one type of particle has substantially zero electrophoretic mobility.

5. An electrophoretic medium according to claim 3 wherein the two types of particles bear charges of the same polarity but differ in electrophoretic mobility.

6. An electrophoretic medium according to claim 1 wherein the capsule walls of a plurality of capsules are merged with one another, so that the medium comprises a plurality of bubbles, each containing the electrophoretically mobile particles and the gaseous suspending medium, the bubbles being dispersed in a continuous solid phase.

7. An electrophoretic medium according to claim 1 wherein the gaseous suspending medium comprises carbon dioxide.

8. An electrophoretic display comprising an electrophoretic medium according to claim 1 and at least one electrode disposed adjacent the electrophoretic medium and arranged to apply an electric field to the medium.

Claims 9-20. (Cancelled).

EVIDENCE APPENDIX

[None]

RELATED PROCEEDINGS APPENDIX

[None]